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The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210

AN UPDATE ON RURAL SOLID WASTE MANAGEMENT IN OHIO

By

Fred J. Hitzhusen

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Fred J. Hitzhusen*

Introduction

Solid waste (better known as garbage or trash) has been around a long time. Most of the solid waste of earlier times was organic (e.g., food, cloth, and wood) and decomposable. As mans' standard of living improved, stone and ceramic materials came into use followed by metals and glass and finally today's multitude of synthetics. The generation of solid waste has grown proportionately to over 200 million tons annually in the United States, or almost a ton per person per year. Improper management of these increasing quantities of solid waste can and has resulted in some serious health, nuisance, air and water pollution and energy conservation problems.

Many rural areas in Ohio have experienced an increase in roadside dumping of solid waste. This is particularly true since the passage of Solid Waste Disposal and Anti-Stream Dumping Laws in 1967 and the recent implementation of Ohio Environmental Protection Agency open burning standards. The former legislation resulted in the closing of over 1,300 rural township open dumps and the establishment of sanitary landfills in most counties. The increases in travel time to and user charges at landfills has made legal solid waste disposal much more inconvenient and costly for many rural residents. A number of solid waste storage and collection pilot projects have been implemented in rural Ohio in response to this problem.

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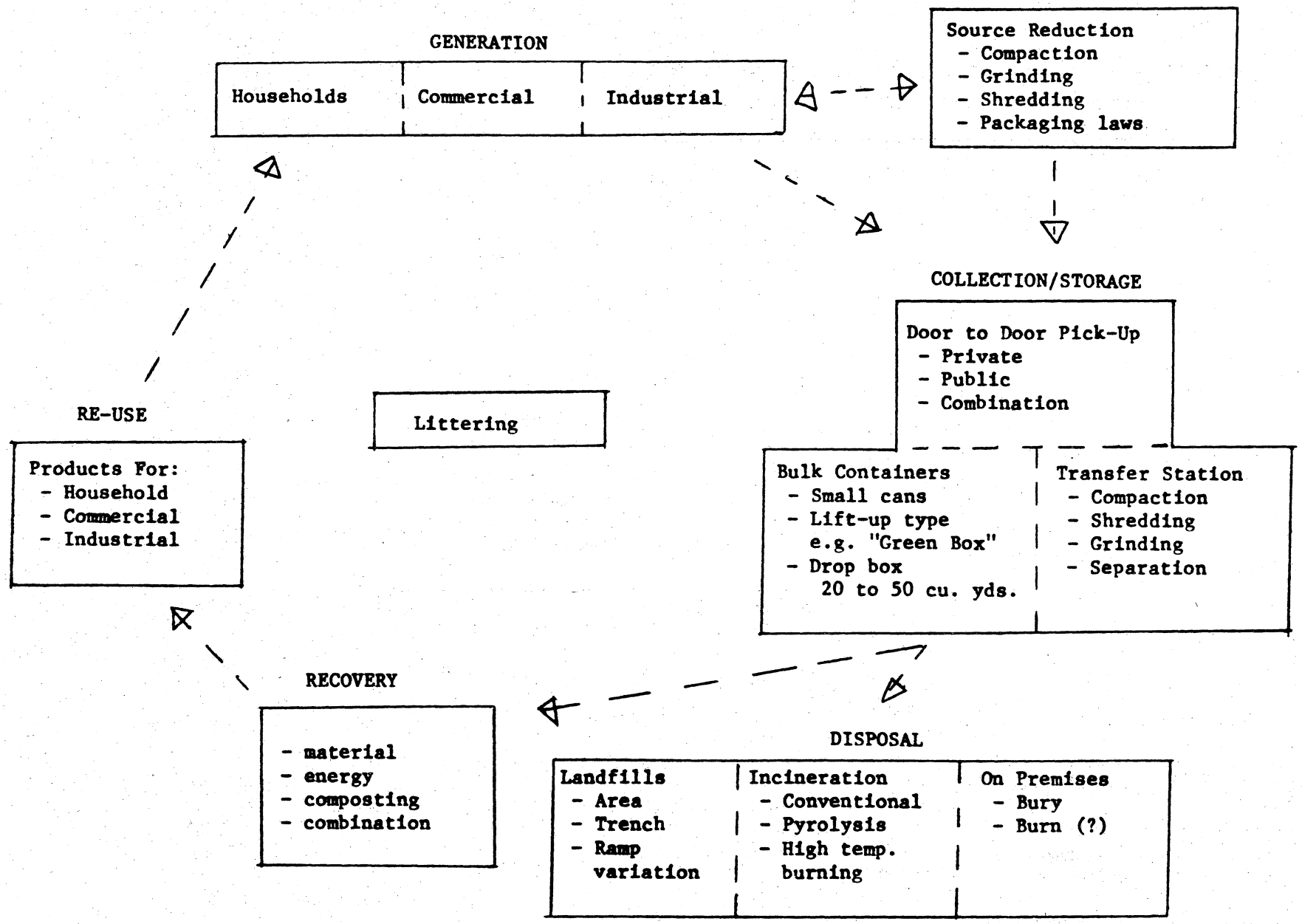
*Assistant Professor, Resource Economics, Department of Agricultural Economics and Rural Sociology, The Ohio State University.

Problems are being encountered at many of the so-called sanitary landfills due to inadequate daily cover and leachates seeping and flowing into underground and surface water supplies. There is an increasing concern over the proper disposal of certain hazardous and/or chemical materials. The limited capacity of many existing sanitary landfills and the resulting search for suitable new sites has encountered increasing land costs and resistance from many private landowners. These factors combined with the "energy crisis" have resulted in more serious discussions of the potential for various forms of resource recovery (e.g. materials, energy, composting) for managing the solid wastes in major urban and adjoining rural areas of Ohio.

A discussion of solid waste management can proceed best within the confines of a framework. Figure 1 provides this framework by outlining the interrelationships of the various source reduction, storage, collection, disposal and resource recovery alternatives in a total systems approach to solid waste management. Appendix A defines many of the terms commonly used in solid waste management. Appendix B presents four sample budgets for rural solid waste storage, collection and disposal developed by the U.S. Environmental Protection Agency [5].

Building on the foregoing information and some preliminary research findings in Ohio, this bulletin will describe the solid waste storage, collection, disposal and recovery facilities and practices that have been implemented, to date, in Ohio's rural communities. Some evaluation is made of these existing systems and some suggestions offered for the future management of solid waste in rural Ohio.

FIGURE I SOLID WASTE MANAGEMENT SYSTEM COMPONENTS



Storage and Collection

Solid waste storage involves placing garbage and other refuse in containers by a household or business between the time it is produced and collected. It is an important phase of the solid waste system from the standpoint of controlling disease carrying rats and flies. Storage containers include metal and plastic cans, plastic bags, lift-up (green box), large drop type refuse containers and various types of compaction pits and trailers used in conjunction with transfer stations.

Collection is the most expensive component and may account for as much as 80 percent of the total costs of solid waste management [8]. There are several methods of providing solid waste collection service. The public type of service is owned and operated by a city, village, township, county or special sanitary district. These political subdivisions may also contract with an individual or private company to collect solid wastes according to conditions stated in a contract. A private collection service owned and operated by an individual or private company is usually paid for directly by the individual customer with an annual cost of $24-$60 per household. Finally, individuals may haul their own solid waste to a disposal or recovery facility.

Several townships in Wayne (see Figure 2) and Coshocton Counties have experimented with small (2 to 8 cu. yd.) lift-up type bulk container systems. County and township government contracted with a private hauler

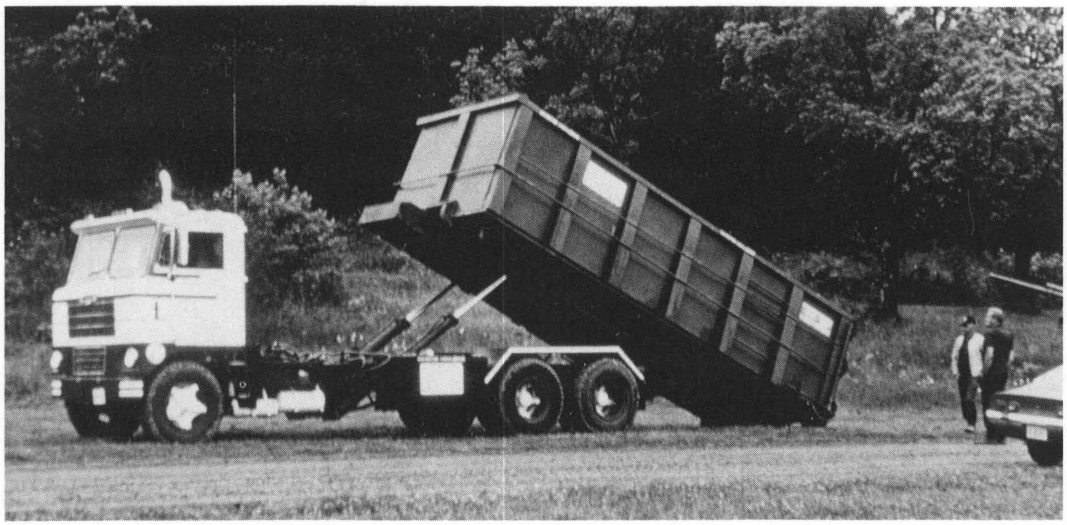
for the provision of these "green box" pilot projects.[1/] Meigs County currently has a county-wide publicly owned and operated small bulk container system. Jackson County has completed a plan and submitted a funding proposal to the Appalachian Regional Commission for a county-wide "green box" type storage and collection system. Several other counties in Planning Region 7 may implement systems similar to those in Meigs and Jackson as a result of a current study of solid waste management in this 10 county (Brown, Highland, Adams, Ross, Pike, Scioto, Vinton, Jackson, Lawrence and Gallia) area of southern Ohio.

There are a few examples of larger (20 to 50 cu. yd.) drop type bulk containers in use in rural Ohio. Knox County is utilizing a 30 cu. yd. container (see Figure 2) in a central location in each of two townships (Pike and Union). County, township, and village government are sharing the cost out of general revenues and contracting with a private hauler for the service. Coshocton County has a similar system in three townships (Keene, Tuscarawas and Franklin) that has replaced the earlier small container system. The annual contract price is $2,000/township for township populations of approximately 6,000 residents. York Township in Tuscarawas County recently implemented a similar approach which utilizes a 20 cu. yd. container.

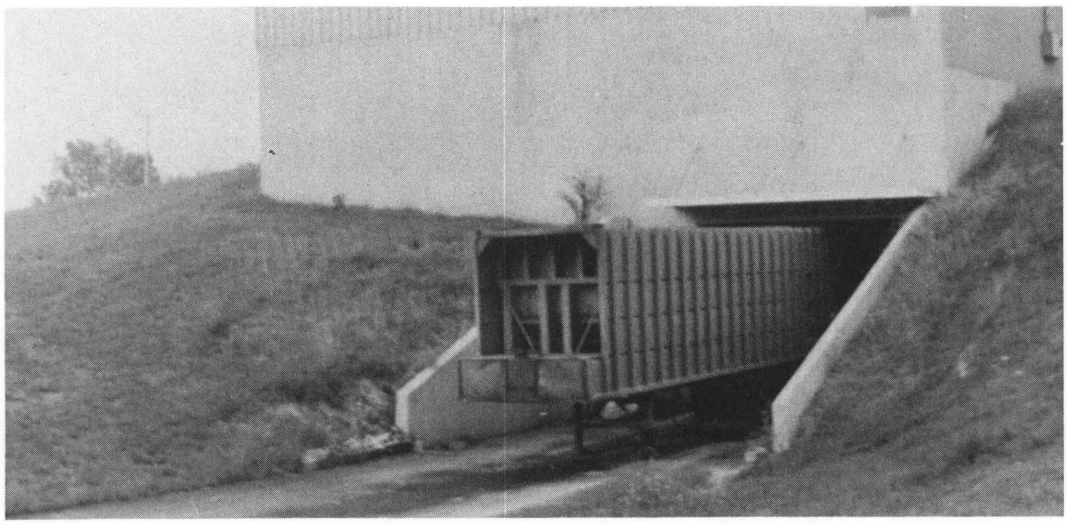
1/ A recent study (ESS 501) at Ohio State University evaluated the Wayne County (Clinton and Plain Townships) system in terms of its impact on roadside littering, use and abuse of the system, costs, etc. Annual costs per rural household to county and township government were about $7.50. Some problems were encountered with overflow and vandalism at some of the box sites. A comprehensive feasibility study of solid waste management in Wayne County is analyzing most of the alternatives outlined in Figure 1. This study will be completed by February 1, 1975. Copies of both studies can be obtained by writing the Department of Agricultural Economics and Rural Sociology at Ohio State University.

Figure 2: Three solid waste storage and collection systems in use in Rural Ohio

Green Box Pilot Project, Clinton Township, Wayne County



Large (30 cu. yd.) drop box and truck in Union Township, Knox County



Transfer station and compactor trailer in Van Wert County

Belmont County has a transfer station type system operated by the Buckeye Reclamation Company. A truck tractor and compactor trailer are parked at each of two ramp type pick-up stations in the county. To dump into the compactor trailers private haulers must pay $4.75/ton and county residents are charged according to the size of their vehicle. The solid waste is then hauled to a privately operated (by Buckeye) sanitary landfill for disposal. Van Wert County has a publicly operated transfer station (see Figure 2) where the solid waste is unloaded in a push pit, hydraulically compacted into a transfer trailer and hauled to a private resource recovery and landfill operation in Fort Wayne, Indiana. Private haulers and residents of Van Wert County pay a drop charge of $10.50/ton at the transfer station.

Disposal

The primary methods of solid waste disposal include sanitary landfills, incineration and disposal at the source. It may be possible for a few private households and commercial or industrial establishments to legally bury or burn their own solid wastes. However, the large size economies[2/] associated with sanitary landfills, and recent EPA open burning laws[3/] make this an unrealistic alternative for most solid waste. Compared to sanitary landfills, incineration of solid waste is usually three to four times more costly. Incineration also leaves a residual ash which must be disposed of

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2/ A recent study at Purdue University found a four-fold decrease ($4.20 to $.80) in average annual costs/ton when landfill capacity increased from 40 to 750 tons/day [3].

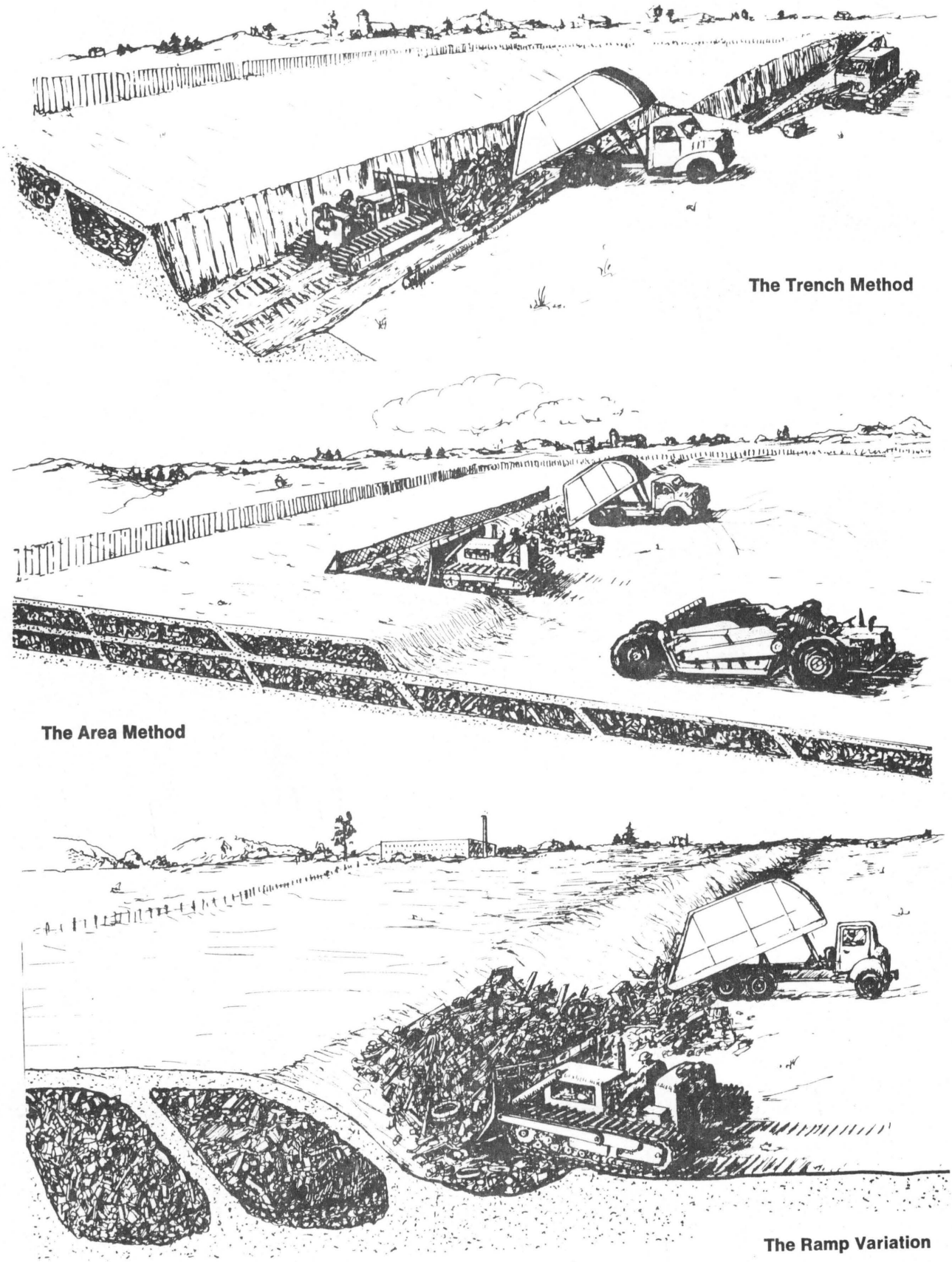
3/ Open burning is prohibited within 1,000 feet of any municipal corporation having a population of 1,000 to 10,000 persons and within one mile of any municipal corporation having a population of 10,000 or more [11].

at a landfill, and it may pollute the air. With the sanitary landfill trench, area or ramp variation method (see Figure 3), the solid waste is dumped, spread, compacted and covered with soil at the end of each day. When properly done, it is currently the most feasible method of solid waste disposal, particularly in rural areas.

Sanitary landfills may be publicly or privately owned and operated. A nationwide survey of solid waste facilities in 1968 found 79 percent of the sanitary landfills were publicly owned and 21 percent were privately owned [10]. Public/private landfill ownership in Ohio in 1968 was about the same as for the nation as a whole. Since 1968 the situation in Ohio (in terms of number of sanitary landfills) appears to have moved toward private ownership. Of the 284 licensed sanitary landfills in Ohio in 1974, 152 (or 54 percent) were private and the remainder public. In non-metropolitan (non-SMSA) counties of Ohio, 76 (or 59 percent) of the 129 licensed sanitary landfills in 1974 were private and the remainder public. To this author's knowledge there are no solid waste incinerators operating in rural Ohio.

As indicated earlier, most economic analyses of sanitary landfills have found significant size economies [3]. The general conclusion for rural areas is that it is usually more efficient to have no more than one or two landfills per rural county. In 1974 almost half of the non-metropolitan (non-SMSA) counties in Ohio had two or more licensed sanitary landfills. The number of landfills per county were distributed as follows:

Figure 3 Sanitary Landfill Methods



Source: [17]

Number of Landfills	Number of Counties
1	32
2	12
3	6
4	5
5	4
6	2

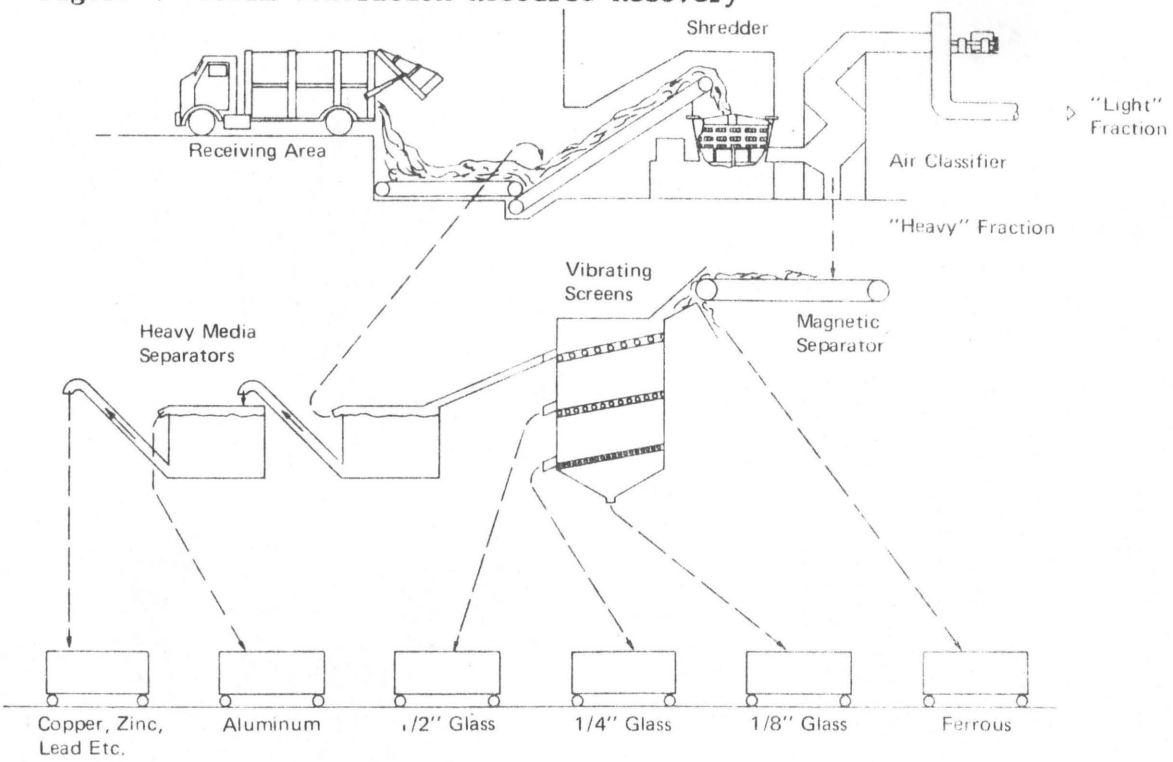
It would appear that some reduction in the number of sanitary landfills in several counties could result in reduced costs of solid waste disposal.

Resource Recovery

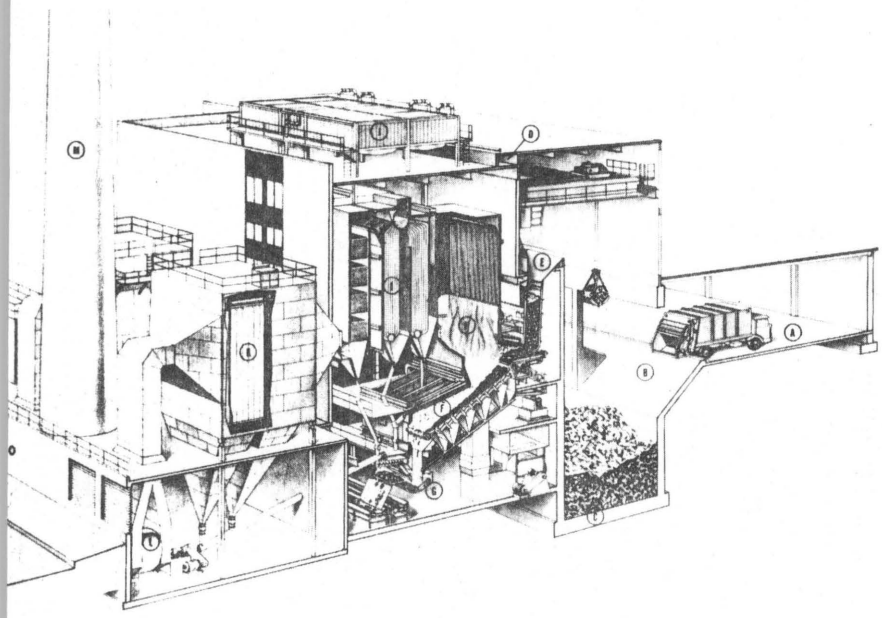
Resource recovery from solid waste has been limited in the past because of inadequate economic incentives. However, increasing concern over the environmental consequences of landfill leachates and the recent "energy crisis" related price increases of many exhaustible resources have heightened interest in resource recovery. The primary types of resource recovery are: (1) material (e.g. metal, glass, paper, etc.), (2) energy (dry, gas, and liquid fuel), (3) composting, and (4) some combination of the above three types. Solid waste resource recovery operations typically involve grinding or shredding of the waste and separation by liquid slurry or an air classifier. The lighter components such as paper, plastic and most food remanents become a fuel, usually for steam generation (see Figure 4). The heavier components such as glass, metal and some heavier plastics are run through a magnetic separater for further sorting before re-use.

The keys to economically feasible resource recovery appear to be a large volume of solid waste supplied on an uninterrupted basis over an

Figure 4 Steam Generation Resource Recovery



COMBUSTION POWER CORP. PROCESS MATERIAL RECOVERY SYSTEM



- **A** Enclosed tipping area preceded by electronic truck scale.
- **B** Sloped truck discharge apron.
- **C** Drainable storage pit of 40-hour capacity, operating at ¼-in. wg negative pressure.
- **D** Main combustion air duct connecting over-the-pit louvers with forced draft fan in basement.
- **E** Oversized, eccentric charging hoppers with protective aprons.
- **F** Reverse reciprocating grates with compartmentalized underfire air and siftings zones.
- **G** Reciprocating, pusher type, semi-dry residue discharger.
- **H** Furnaces with high configuration water cooled walls and thin refractory covering in high flame areas.
- **I** Superheaters, convectors and economizers with gravity discharge of fly ash and soot cleanings into residue discharger.
- **J** Steam condensate and hot water cooling system.
- **K** High fractional efficiency precipitators of the dry type with gravity-conveyor fly ash handling system.
- **L** Induced draft fans.
- **M** Brick, refractory lined exhaust stack.

Source: [1]

extended time period. The National Center for Resource Recovery in Washington, D. C. has incorporated these key elements into a model resource recovery system to serve most of the needs of a community of 200,000 people. The proposed recovery plant has a processing capacity of 500 tons/day and an estimated capital cost of $2.4 million, exclusive of land. Connecticut recently created a state authority for resource recovery and adopted a state-wide plan emphasizing resource recovery on a regional basis. The state is divided into "solid waste sheds" having a population base of at least 350,000, the level where resource recovery is considered economically feasible. A similar plan has also been adopted in Wisconsin [19], and Ohio EPA is currently assessing the feasibility of regional resource recovery based on the 15 sub-state planning regions in Ohio [14].

Franklin, Ohio has been operating a 150 ton/day capacity EPA solid waste recovery demonstration plant since 1968 that utilizes a slurry technique for separating the waste and combining it with sewage sludge. One of the problems of this operation has been an inadequate volume of solid waste to operate at or near capacity. The drop charge of $6.50/ton is higher than the user charges at sanitary landfills in the area. As a result, most of the solid waste from the rural areas and smaller communities surrounding Franklin goes to landfills. The Toledo Metropolitan Area Council of Governments is currently studying alternatives for establishing a resource recovery facility in the Toledo region. The region being considered includes Lucas, Wood, and Ottawa counties in Ohio and three Michigan townships adjacent to Toledo.

SUMMARY AND FUTURE IMPLICATIONS

Various packaging laws (e.g. The Oregon Bottle Law) and waste charges have the potential of helping reduce the increasing rate at which solid waste is being generated. However, the evidence to date suggests that the total volume of solid waste will probably continue to increase for some time in both urban and rural areas. Accordingly, most solid waste management strategies will focus on identifying more efficient and environmentally sound alternatives for storing, collecting, disposing of and increasingly recovering solid wastes.

An increasing number of rural counties and townships in Ohio are adopting various types of bulk container systems. The experience and research to date on the small lift-up container or "green box" system indicates some problems of overflow and abuse at the box sites and annual costs of $8-$15 per household. Increasing box size, reducing the number of box sites to no more than one per township, and providing some supervision appear to be helpful modifications even though some increase in private travel costs may result. Less is known about the larger drop type container. Limited experience with 20 and 30 cubic yard drop type containers indicates fewer problems with large, bulky items but some problems have been encountered from small private haulers illegally dumping in the large containers where they are not supervised. Preliminary costs of the drop type container system have been less than or equal to the small lift-up container system.

The evidence is even more limited on the transfer station option for rural areas of Ohio. The two transfer station examples cited ranged from a cost of $4.75/ton to $10.50/ton. However, the more costly system in Van Wert County has compaction capacity, is covered to prevent wind scatteration of the waste and is operating at considerably less than full capacity. Some unit cost reductions could be realized by increasing the volume of waste handled at the Van Wert facility.

There appears to be a trend since 1968 toward private ownership of sanitary landfills in both urban and rural Ohio. However, public ownership may facilitate better control of landfill operations. It may also help reduce the excess number of sanitary landfills in some counties and result in lower costs per unit of solid waste disposed. Private operation of publicly owned sanitary landfills can be realized through contractual arrangements with the local unit(s) of government.

Resource recovery may continue to be non-feasible for many of the rural areas of Ohio that are not in close proximity to major urban areas. Connecticut is a relatively small and densely populated state and caution must be exercised in making wholesale applications of the Connecticut Plan. Alternatively, the National Resource Recovery Center model has been developed for a population of 200,000. Based on 1970 U.S. Census data, only the planning region in Northwest Ohio (4a) has less than a 200,000 population base and this region is in reasonably close proximity to Fort Wayne, Indiana where a resource recovery facility is already in operation.

As a minimum, rural counties of Ohio in close proximity to the Cleveland-Akron, Cincinnati-Dayton, Columbus and Toledo metropolitan areas need

to be aware of the rapidly changing economics and technology of resource recovery. Several of these rural counties could be part of an operational regional resource recovery system in the not too distant future. If so, more research is needed on the operational and economic feasibility of various large bulk container and transfer station alternatives for moving all or part of the solid waste from these rural areas to the urban resource recovery facilities.

Appendix A Solid Waste Definitions

1. Composting - means the controlled biological decomposition of solid organic waste material under aerobic conditions.

2. Facility - means any device, mechanism, equipment, or building used for stabilization, conversion, permanent storage, transfer, or incineration of solid waste, whether or not generated on the premises where the facility is located, or for resource recovery.

3. Ground Water - means any water below the surface of the earth in a zone of saturation.

4. Hazardous Material - means material that is toxic, poisonous, irritating, sensitizing, radioactive, explosive, or biologically infectious, or that may have either acute or chronic effects on the health of individuals coming into contact with such material.

5. Health District - means a city or general health district as created by or under authority of Chapter 3709. of the Ohio Revised Code.

6. Incinerator - means any equipment, machine, device, article, contrivance, structure, or part of a structure used to burn solid waste.

7. Leachate - means the substance that results when liquid percolates through solid waste.

8. Open Dumping - means the depositing of solid wastes into a body or stream of water, or onto the surface of the ground at any location other than a solid waste disposal site or facility licensed under Ohio Revised Code Chapter 3734 and these Chapters, EP-20 and EP-33.

9. Resource Recovery - means the extraction of usable materials and/or energy from solid wastes through processes of extraction, conversion, or separation.

10. Sanitary Landfill - means a method of disposing of solid waste on land without creating nuisance or hazards to public health or safety, and without causing or contributing to air and water pollution, by utilizing the principles of engineering to confine the solid waste to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation, or at such more frequent intervals as may be necessary.

11. Site - means any location, place, or tract of land used for stabilization, permanent storage, conversion, transfer, or burial of solid wastes, whether or not generated on the premises where the site is located, or for resource recovery.

12. Solid Wastes - means such unwanted residual solid or semisolid material as results from industrial, commercial, agricultural, and community operations, excluding earth or material from construction, mining, or demolition operations and slag and other substances which are not harmful or inimical to public health, and includes, but is not limited to, garbage, combustible and non-combustible material, street dirt, and debris.

13. Solid Waste Disposal - means the final disposition of solid wastes.

Appendix B Sample Budgets for Rural Solid Waste Management

In deciding upon a solid waste management system, the level of service to be provided must be weighed against the expected costs. If cost comparisons are the only consideration between alternatives, the result can be that an inadequate system is selected for an area.

Developing cost estimates involves determining the equipment, facilities, land, personnel, and supplies needed to operate a particular alternative. Equipment dealers and others using collection and disposal equipment can provide a valuable source for this information. Trade and public works magazines can also be an information source.

The sample budgets which follow indicate the type of costing which would occur for the different alternatives previously discussed. The actual costs for a specific area can vary considerably from these examples, and each area must generate their own cost estimates in more detail depending upon their own particular needs. The sample budgets are based on the following assumptions:

1. A rural population of 20,000 people (6,000 households) and 100 small businesses are distributed over a 2,600-km^2 (1,000-mi^2) service area.

2. The average weekly volume of waste collected is .2 m^3 (.25 yd^3) per household for transfer stations and .15 m^3 (20-yd^3) per household for other types of collection. An average of .76 m^3 (1.0 yd^3) per week is collected from each small business. For the house-to-house service and small container systems, the waste generators haul most bulky wastes directly to the landfill.

3. House-to-house collection occurs at the resident's mailbox or along the main roads traveled by the collection vehicle. Rear-loading vehicles with a two-man crew collect once a week.

4. The small containers are emptied on an average of twice weekly.

5. The transfer stations have no attendants at the site and each site requires two or three services a week. A pull-trailer is utilized on some of the routes to haul two containers at a time.

6. Any of the three collection systems would use the same centrally located sanitary landfill.

1. Regional House-To-House Collection System

Capital Costs

Equipment

7 15.3-m^3 (20-yd^3) rear-loading compaction units @ $8,000	$ 56,000
7 truck chassis @ 8,500	59,500
1 pickup truck	3,000
TOTAL	$118,500

Annual Costs

Labor (14 men @ $9,000)[1]	$126,000
Manager/supervisor (1/2 time)[2]	6,500
Secretary/bookkeeper (1/2 time)[2]	2,500
Billing expense (6,100 @ $2.00)[3]	12,200
7 Compaction units depreciation (5 yr @ 7%)	13,700
7 Truck chassis depreciation (5 yr @ 7%)	14,500
Pickup truck depreciation (5 yr @ 7%)	700
Fuel, oil, grease, etc.	7,000
Equipment maintenance	12,000
Insurance	6,000
Office supplies and miscellaneous	2,000
TOTAL	$203,100

[1]All labor costs given are total costs including fringe benefits.
[2]Also handles other responsibilities.
[3]Assumes billing cost of $2.00 per year per service.

Source: [5].

2. A Regional Small Container System

Capital Costs

Site preparation costs: (assume 65 sites @ $100)	$ 6,500
Equipment	
2 22.9-m^3 (30-yd^3) front-loading compaction units @ 13,000	26,000
2 Truck chassis @ $19,000	38,000
1 Pickup truck	3,000
130 4.6-m^3 (6-yd^3) containers @ $325	42,250
TOTAL	$115,750

Annual Costs

Labor (2 drivers @ $9,000)[1]	$ 18,000
Manager/supervisor (1/4 time)[2]	3,300
Secretary/bookkeeper (1/4 time)[2]	1,300
Site depreciation (8 yr @ 7%)	1,100
2 Compaction units depreciation (5 yr @ 7%)	6,300
2 Truck chassis depreciation (5 yr @ 7%)	9,300
1 Pickup truck depreciation (5 yr @ 7%)	700
130 4.6-m^3 (6-yd^3) containers depreciation (8 yr @ 7%)	7,100
Fuel, oil, grease, etc.	4,000
Equipment maintenance	6,000
Insurance	2,700
Office supplies and miscellaneous	2,000
TOTAL	$ 61,800

[1]All labor costs given are total costs including fringe benefits.
[2]Also handles other responsibilities.

Source: [5].

3. A Regional Transfer Station System

Capital Costs

Land Acquisition (11 sites @ $750)[1]		$ 8,250
Site Construction		
Clearing, drainage, access road, etc.	$ 5,000	
Concrete retaining walls and pad for containers	5,000	
	10,000	
11 sites @ $10,000		110,000

Equipment

14 38.2-m^3 (50-yd^3) containers @ $3,000	42,000
2 Truck chassis @ 23,000	46,000
2 Understructures @ 7,500	15,000
2 Pull-trailers @ 16,000	32,000
TOTAL	$253,000

Annual Costs

Labor[2] (1 driver/mechanic @ $9,000) (2 drivers @ 9,000)	27,000
Manager/supervisor (1/4 time)[3]	3,300
Secretary/bookkeeper (1/4 time)[3]	1,300
Site depreciation (15 yr @ 7%)	12,100
2 Pull-trailers (5 yr @ 7%)	7,800
2 Truck chassis depreciation (5 yr @ 7%)	11,200
14 38.2-m^3 (50-yd^3) container depreciation (8 yr @ 7%)	7,000
Fuel, oil, grease, etc.	4,000
Equipment maintenance	9,000
Insurance	2,300
Office supplies and miscellaneous	2,000
TOTAL	$ 87,000

[1]There are actually 12 sites available for the region since waste is taken to the sanitary landfill by people in the nearby area.
[2]All labor costs given are total costs including fringe benefits.
[3]Also handles other responsibilities.

Source: [5].

4. A Regional Sanitary Landfill

Capital Costs

Site	
Land acquisition (20 ha @ $1,000, or 50 acres @ $400)	$20,000
Site preparation, surveys, and land clearing	9,000
Access road	10,000
Site fencing across road	1,500
Scalehouse	5,000
Scales	8,500
Equipment	
1 Crawler tractor	45,000
TOTAL	$99,000

Annual Costs

Labor (1 operator @ $10,000; 1 assistant @ $9,000)[1]	$19,000
Manager/supervisor (1/4 time)[2]	3,300
Secretary/bookkeeper (1/2 time)[2]	2,500
Site preparation, construction, and scale depreciation (10 yr @ 7%)[3]	4,800
Equipment depreciation (8 yr @ 7%)	7,500
Equipment maintenance	5,000
Fuel, oil, grease, etc.	600
Utilities	800
Insurance	200
Office supplies and miscellaneous	2,000
TOTAL	$45,700

[1]All labor costs given are total costs including fringe benefits.
[2]Also handles other responsibilities.
[3]The land is not depreciated.

Source: [5].

BIBLIOGRAPHY

1. A Proposed Plan of Solid Waste Management For Connecticut, The General Electric Company in cooperation with the Connecticut Department of Environmental Protection, June 1973.

2. Albert, James G., et. al. "The Economics of Resource Recovery from Municipal Solid Waste", Science, Volume 183, March 15, 1974, pp. 1052-1058.

3. Clayton, Kenneth C. and Huie, John M. "Sanitary Landfill Cost", EC-412, Cooperative Extension Service, Purdue University, Lafayette, Indiana.

4. Colonna, Robert A. and Cynthia McLaren. Decision Makers Guide in Solid Waste Management, U.S. Environmental Protection Agency, SW-127, 1974.

5. Goldberg, Theodore L. Improving Rural Solid Waste Management Practices, SW-107, U.S. Environmental Protection Agency, 1973.

6. Hitzhusen, Fred J. and Karkouti, Said. Evaluation of a Rural Solid Waste Storage and Collection System: The Wayne County Ohio "Green Box" Pilot Project, ESS 501, Department of Agricultural Economics and Rural Sociology, Ohio State University, November 1973.

7. Hitzhusen, Fred J. "Proposed Wayne County Solid Waste Management Feasibility Study". Department of Agricultural Economics and Rural Sociology, March 1, 1974.

8. Huie, John M. Solid Waste Management: Storage, Collection and Disposal, EC-397, Cooperative Extension Service, Purdue University, Lafayette, Indiana, 1972.

9. Kiefer, Irene. "The Salvage Industry: What It Is - How It Works", U.S. Environmental Protection Agency, SW-29c.1, 1973.

10. Klee, Albert J. "The Role of Facilities and Land Disposal Sites", An Interim Report 1968 National Survey of Community Solid Waste Practices, Department of Health, Education, and Welfare, Washington, D. C., 1968.

11. Ohio Environmental Protection Agency, Open Burning Standards, Regulation EP-12, September 10, 1973.

12. Ray, John R. "Planning For Regional Solid Waste Management", Ohio Cities and Villages, July 1973.

13. Schultz, Robert L. "Waste Disposal: The Connecticut Approach", Ohio Cities and Villages, February 1974.

14. "Solid Waste Management in Ohio" Resource recovery recommendations of the Solid Waste Management Task Force of the Ohio Commission on Local Government Services, October 12, 1973.

15. Solid Waste Training Unit, Ohio Environmental Protection Agency. Transfer Stations 1973: Solid Waste Management Handbook, 1973.

16. Toftner, Richard O. Developing a Local and Regional Solid Waste Management Plan, SW-101, U.S. Environmental Protection Agency, 1973.

17. U.S. Department of Health, Education, and Welfare. Sanitary Landfill Facts, Publication SW-4ts, 1968.

18. U.S. Environmental Protection Agency. Solid Waste Management: Recycling and the Consumer, Washington, D. C., 1974.

19. "Wisconsin Solid Waste Recycling: An Innovative Program and Legislation", Recycling Task Force on Solid Wastes," Madison, Wisconsin, May 1974.